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ORIGINAL ARTICLE

Snodgrass (tubularized incised plate) urethroplasty for distal penile hypospadias: impact of patient age and operative time

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ABSTRACT

OBJECTIVES: To determine the outcomes of hypospadias correction using the Snodgrass (tubularized incised plate) technique, specifically examining the impact of patient age and surgery duration on overall results and to evaluate cosmetic outcomes based on parent and patient satisfaction scores.

METHODS: This prospective cohort study was conducted between January 2021 and July 2022 in the Pediatric Surgery Department of Lady Reading Hospital, Peshawar-Pakistan. Children aged 6 months to 16 years with distal penile hypospadias repaired using the Snodgrass technique were included. Exclusion criteria were previous hypospadias repairs, proximal hypospadias, and loss to follow-up. All patients were monitored for 3 months' post-surgery for complications and cosmetic outcomes, assessed using the pre-validated Pediatric Penile Perception Scale.

RESULTS: One hundred & thirty-six patients were divided into three groups: Group-A (6–18 months) with 27 patients (19.8%), Group-B (18 months–3 years) with 51 patients (37.5%), and Group-C (>3 years) with 58 patients (42.6%). The most common complication was urethrocutaneous fistula (9.6%), followed by meatal stenosis (5.1%) and bleeding (3.7%). Group-A had the highest rates of urethrocutaneous fistula (25.9%) and skin necrosis (7.4%) with p-values of 0.004 and 0.017, respectively. Patients with surgical durations ≤74 minutes had a significantly higher incidence of residual chordee. Over two-thirds of parents and patients reported satisfaction with cosmetic outcomes after 3 months.

CONCLUSION: Snodgrass technique effectively corrects hypospadias, with both patient age and surgical duration significantly impacting outcomes. Delayed surgery, combined with careful technique, led to fewer complications and improved cosmetic results, contributing to high satisfaction among families.

KEYWORDS: Hypospadias (MeSH); Snodgrass Repair (Non-MeSH); Wound Healing (MeSH); TIP Repair (Non-MeSH); Urethrocutaneous fistula (Non-MeSH); Fistula (MeSH); Meatal stenosis (Non-MeSH).

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INTRODUCTION

Distal penile hypospadias is a common urological anomaly in children.[1] With an incidence of 1 in 150 to 300 males, it is second only to undescended testis among congenital defects in boys.[2] Patients not only experience cosmetic disfigurement of the genitalia but also functional disabilities, which vary depending on the severity. These issues include problems with urination, psychological challenges, and difficulties in semen deposition, which can affect fertility.[3]

The management of hypospadias is primarily surgical.[4] There are over 200 different procedures available for the correction of hypospadias.[5] Snodgrass repair, also known as tubularized incised plate (TIP) urethroplasty, has become one of the most widely used methods for distal hypospadias repair due to its simplicity, lower complication rates, and the use of native urethral plate to create a neourethra with a normal-looking meatus.[6-8] The primary goal of modern hypospadias surgery is to create a penis with normal appearance and function. Like other surgical procedures, TIP repair can have complications. Urethrocutaneous fistula, with an incidence ranging from 2-16%, is the most common complication.[9,10] Other complications include bleeding, wound infection, wound dehiscence, meatal stenosis, residual chordee, and skin necrosis.[11]

The optimal age for hypospadias repair remains a subject of debate. The American Academy of Pediatrics recommends performing the surgery between 6 and 12 months of age, whereas some suggest waiting until a later age.[12] Prolonged operative time is often considered linked with higher complication rates, prompting a focus on reducing operative duration to enhance outcomes.[13] Typically, hypospadias repair surgeries last between 60 and 120 minutes.[14] However, it remains unclear whether the length of the operation or the age at surgery impacts the final outcome. This study was planned to fill the gap by investigating the impact of patient age and operative time on the outcomes of hypospadias repair. Our primary objective was to evaluate the results of hypospadias correction using the Snodgrass (TIP) technique, with a focus on determining whether age and surgery duration affect the overall outcome. Furthermore, cosmetic outcomes were assessed based on parent and patient satisfaction scores.

METHODS

This prospective cohort study was conducted in the Department of Pediatric Surgery at Lady Reading

Hospital, Peshawar, from January 2021 to July 2022, following ethical approval (521/LRH/MTI).

The study included the following criteria for participant selection:

• Children with distal penile hypospadias repaired using the Snodgrass technique

• Ages ranging from 6 months to 16 years

The following children were excluded from the study.

• History of previous hypospadias repair

• Proximal hypospadias

• Patients who lost to follow-up

All surgeries were performed using the Snodgrass (TIP) repair technique by a surgeon with a minimum of three years of experience in hypospadias surgery. The standard procedure involved marking the urethral plate and skin, placing stay sutures in the foreskin and glans, making a midline incision, and dissecting the skin flaps. Chordee tissue was excised, and an artificial erection test was conducted before mobilizing the urethral plate, with a chordee angle of up to 15 degrees considered acceptable. The urethral plate and glans wings were mobilized, followed by the creation of a TIP incision. A double-layer continuous urethroplasty was performed over a size 7 or 8 Fr Nelaton tube using 6/0 vicryl sutures. Dartos fascia was then placed over the repair for added protection. Glansplasty was performed, and circumcision was completed. A sandwich dressing was applied to prevent postoperative edema and bleeding. Prophylactic antibiotics were administered to all patients, and operative time was recorded for each repair.

The urethral stent was removed on the 10th postoperative day during the first follow-up visit. Subsequent follow-ups were conducted one month and three months postoperatively in the outpatient department. Patients were monitored for complications and cosmetic outcomes using the pre-validated Pediatric Penile Perception Scale (Appendix 1).[15] Complications were categorized by age group and operative time, and a chi-square test was applied to determine the p-value for each variable.

RESULTS

A total of 136 patients were included in the study, categorized into three age groups: Group A (6 to 18 months) comprised 27 patients (19.9%), Group B (18 months to 3 years) included 51 patients (37.5%), and Group C (over 3 years) consisted of 58 patients (42.6%). The age of participants ranged from 7 months to 15 years, with a mean surgical duration of 78 ± 0.02 minutes. The recorded complications are detailed in Table I, with urethrocutaneous fistula (n=13; 9.6%) being the most prevalent complication, followed by meatal stenosis (n=7; 5.1%) and bleeding (n=5, 3.7%). Additionally, over two-thirds of patients and their parents expressed satisfaction with the cosmetic appearance, as illustrated in Table II.

No significant difference was observed between the age groups in terms of rates of bleeding complications, wound infection, wound dehiscence, meatal stenosis, and residual chordee. However, statistically significant difference was observed between different age groups for skin necrosis ($p = 0.017$) being highest in the age group A (7.4 %), and for urethrocutaneous fistula ($p = 0.004$) which is also observed to be with highest occurrence in the same age group (25.9) followed by group B (7.8 %) and group C (3.4 %), as depicted in Table III.

The incidence of all the complications except residual chordee was similar among both the groups of surgery duration. The incidence of residual chordee was significantly higher in the group with ≤74 mins of surgery duration (5.5% vs 0%, $p = 0.059$), shown in Table IV.

DISCUSSION

Our study demonstrated a significant difference in the outcomes of TIP repair for hypospadias across different age groups, particularly regarding the incidence of urethrocutaneous fistula and skin necrosis. Additionally, operative time influenced outcomes concerning chordee correction. Approximately 66% of patients and their parents expressed satisfaction

Table I: Complications observed in hypospadias repair

Complications	Frequency (n=136)	Percentage
Urethrocutaneous fistula	13	9.6
Meatal stenosis	7	5.1
Bleeding	5	3.7
Residual Chordee	4	2.9
Wound infection	3	2.2
Wound dehiscence	3	2.2
Skin necrosis	2	1.5
Total	37	27.2

Table II: Patient and parent satisfaction ratings for cosmetic outcomes after repair of distal penile hypospadias

Satisfaction Level	Frequency (n=136)	Percentage
Very Satisfied	4	2.9
Satisfied	89	65.4
Not satisfied	37	27.2
Very Dissatisfied	6	6.6

Table III: Complications of hypospadias repair across different age groups (n=136)

Complications	Age groups			p – value
	A (n=27)	B (n=51)	C (n=58)	
Urethro-cutaneous fistula	7 (25.9 %)	4 (7.8 %)	2 (3.4 %)	0.004*
Meatal stenosis	2 (7.4 %)	3 (5.9 %)	2 (3.4 %)	0.711
Bleeding	1 (3.7 %)	1 (2 %)	3 (5.2 %)	0.67
Residual Chordee	1 (3.7 %)	2 (3.9 %)	1 (1.7 %)	0.768
Wound infection	1 (3.7 %)	1 (2.0 %)	1 (1.7 %)	0.836
Wound dehiscence	0 (0 %)	1 (2.0 %)	2 (3.4 %)	0.59
Skin necrosis	2 (7.4 %)	0 (0 %)	0 (0 %)	0.017*
Total	14 (51.8%)	12 (23.5%)	11 (18.9%)	

*Statistically significant

Table IV: Impact of surgical duration on complications following hypospadias repair

Complication	Duration of Surgery		p – value
	>74 mins (n=63)	≤74 mins (n=73)	
Bleeding	3 (4.8 %)	2 (2.7 %)	0.532
Skin necrosis	0 (0 %)	2 (2.7 %)	0.186
Wound infection	1 (1.6 %)	2 (2.7 %)	0.648
Wound dehiscence	1 (1.6 %)	2 (2.7 %)	0.648
Meatal stenosis	1 (1.6 %)	6 (8.2 %)	0.081
Urethrocutaneous fistula	4 (6.3 %)	9 (12.3 %)	0.237
Residual Chordee	0 (0 %)	4 (5.5 %)	0.059*
Total	10 (15.8%)	27 (36.9%)	

*Statistically significant

with the cosmetic results.

The literature presents varied outcomes of hypospadias repair, with overall complication rates reported as low as 5% to as high as 61%. [11,16] The most frequently reported complication in existing studies is urethrocutaneous fistula (UCF). Our findings align with this trend, revealing an overall complication rate of 27%, with UCF occurring in 9.6% of cases. Factors contributing to the development of UCF following hypospadias repair include narrowing of the meatus, local tissue ischemia, failure to achieve a watertight anastomosis, and localized skin infection.[17] Meatal stenosis was another important complication in our study, occurring in 5.1% of patients. Literature indicates an incidence ranging from 1% to 17%.[18] The reported causes of meatal stenosis include over-maturation of the meatus and suture dehiscence, leading to contraction of the meatal opening.[19]

The exact incidence of bleeding following hypospadias repair remains underreported in the literature. The primary causes of bleeding include inadequate hemostasis, dissection performed to correct chordee, and injury to the corpus cavernosum. Utilizing adrenaline solutions or bipolar cautery during the procedure has been shown to reduce bleeding.[20] Complications such as wound infection, dehiscence, and skin necrosis are often attributed to factors such as improper scrubbing technique, aggressive dissection, suboptimal surgical techniques, postoperative edema, the instillation of adrenaline into the skin, and inadequate mobilization of flaps and the urethral plate. These issues can lead to closure under tension, resulting in decreased blood supply, ischemia, necrosis, and ultimately, infection and dehiscence.[19,20] To mitigate these complications, it is essential to ensure careful dissection, which maintain proper aseptic techniques, and administer antibiotics as needed.

Chordee correction is a crucial step in hypospadias surgery, with literature reporting an incidence of residual chordee ranging from less than 5% to as high as 20%.[21] In cases of distal hypospadias, the chordee is typically mild and can often be corrected through the degloving of the penile skin. However, in more severe instances, resection of the corpus spongiosum or dorsal plication may be necessary. Failure to perform an artificial erection test, insufficient skin release, and the inability to identify deep chordee can lead to residual chordee following hypospadias repair.[22]

The higher overall complication rates observed in our study compared to other centers may be attributed to factors such as the lack of surgical loupes and rough handling of the tissues during the procedure. Conversely, specialized institutes that focus solely on hypospadias repair typically report significantly lower complication rates.[16] Our institution, being a general pediatric surgery department, addresses a variety of pediatric surgical conditions alongside hypospadias, which may contribute to the increased complication rates relative to dedicated centers.

The primary objective of hypospadias repair is to achieve both optimal functional and cosmetic outcomes.[23] As previously noted, complications following hypospadias surgery are common and can significantly affect cosmetic results and patient/parent satisfaction. Approximately two-thirds of our patients and their parents

reported satisfaction after the procedure. A study conducted in the UK indicated a satisfaction rate exceeding 50%[23], while similar findings were reported in another Canadian study.[24] The higher satisfaction scores observed in our study may be attributed to the less severe chordee, milder degrees of hypospadias, and effective parental counseling prior to the procedure. Lorenzo AJ, et al.,[23] noted dissatisfaction associated with circumcision; however, this was not reported in our study, likely due to circumcision being a religious norm in our country. The primary concerns of parents and patients in our study were the size and shape of the penis.

The appropriate age for performing hypospadias repair remains a topic of controversy. Historically, the ideal age for repair was considered to be around three years, as the delicate tissues and the risks associated with prolonged anesthesia in younger children could jeopardize outcomes. Some studies have even suggested that the ideal age is between six and eight years. However, the American Academy of Pediatrics now recommends performing the repair between 6 to 12 months of age, taking into account advancements in surgical techniques and anesthesia.[12] In our study, patients ranged from 7 months to 15 years of age. The late presentation of some patients can be attributed to factors such as parental unawareness, neglect by family members, misconceptions about religious beliefs—such as the notion that the child will be circumcised by angels—and lack of access to pediatric or plastic surgeons for repair.

Perlmutter AE, et al., demonstrated that early repair of hypospadias, around 6 months of age, leads to better outcomes.[24] Conversely, Weber DM, et al.; reported no significant differences in outcomes based on the age at which hypospadias repair is performed.[12] Our study contradicts both findings, as we observed a higher complication rate in younger age groups compared to older ones. Statistically significant differences were noted for skin necrosis and urethrocutaneous fistula in the lower age group. This emphasizes the need for utilizing surgical loupes to enhance visualization and ensure delicate handling of tissues in smaller children, thereby minimizing tissue trauma and reducing complication rates. Additionally, hyperbaric oxygen therapy (HBOT) has been reported to decrease complications following hypospadias repair.[26] However, our center lacks the facility for HBOT, which may contribute to the higher complication rates observed. Further studies are needed to determine whether the use of HBOT is more beneficial for younger patients compared to older ones, as all our patients did not receive HBOT, yet older children experienced fewer complications.

Operative time is often regarded as an adverse factor influencing surgical outcomes.[13] In our study, however, longer operative times were associated with improved results. Conversely, shorter operative times correlated with a higher incidence of complications. This difference was statistically significant concerning chordee correction, as the incidence of residual chordee was higher in cases with shorter operative times. Notably, there was no significant difference based on age, despite all patients undergoing a standard surgical procedure. This finding highlights the importance of thorough chordee release, which can be time-consuming; in some cases, simple skin release may not suffice to achieve adequate correction. Factors such as long surgical lists, an overburdened surgical team, and performing cases toward the end of the list may contribute to reduced operative times and, consequently, poorer outcomes.

CONCLUSION

Our study demonstrates that patient age and operative time significantly impact outcomes of hypospadias repair using the Snodgrass (TIP) technique. Particularly, younger patients under three years old had higher complication rates, especially for urethrocutaneous fistula and skin necrosis, suggesting that careful timing of surgery is crucial. Contrary to common belief, longer operative times were associated with better outcomes, particularly in chordee correction, highlighting the importance of meticulous surgical technique. Patient and parent satisfaction with cosmetic results supports the effectiveness of the TIP technique across age groups. The observed complication rates highlight the necessity of specialized surgical expertise. We recommend exploring adjunct therapies, for managing complications in younger patients. This study advocates for a balanced approach to hypospadias repair, weighing the urgency of intervention against potential complications to improve surgical practices and patient care.

Limitations and recommendations

Our study is limited by its single-center design, which may affect the generalizability of the findings. Additionally, psychological outcomes were not assessed, which are important for a comprehensive evaluation of hypospadias repair.

We recommend larger, multi-center prospective studies that assess both surgical and psychological outcomes to provide a more complete understanding of the long-term impact of the procedure. Furthermore, randomized controlled trials are necessary to determine the optimal age for hypospadias repair, ensuring better outcomes for patients.

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AUTHORS' CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

FA: Concept and study design, acquisition of data, drafting the manuscript, approval of the final version to be published

KS: Analysis and interpretation of data, critical review, approval of the final version to be published

SSUDS: Acquisition of data, critical review, approval of the final version to be published

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

Authors declared no conflict of interest, whether financial or otherwise, that could influence the integrity, objectivity, or validity of their research work.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request

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